

## TARS AND MINERAL OILS\*

First listed in the *First Annual Report on Carcinogens*

### CARCINOGENICITY

Coal tars and coal tar pitches, and untreated and mildly treated mineral oils are *known to be human carcinogens* based on sufficient evidence of carcinogenicity in humans. There is limited evidence for the carcinogenicity of creosotes in humans; and there were no adequate data available to evaluate the carcinogenicity of highly refined mineral oils (IARC S.7, 1987).

There have been a number of case reports of skin cancer in patients who used tar ointments for a variety of skin diseases. A mortality analysis in the United Kingdom from 1946 showed a greatly increased scrotal cancer risk for patent-fuel workers. Furthermore, a large number of case reports describe the development of skin (including the scrotum) cancer in workers exposed to coal tars or coal-tar pitches. Several epidemiological studies have shown an excess of lung cancer among workers exposed to coal tar fumes in coal gasification and coke production. A cohort study of U.S. roofers indicated an increased risk for cancer of the lung and suggested increased risks for cancers of the oral cavity, larynx, esophagus, stomach, skin, and bladder and for leukemia. Some support for excess risks of lung, laryngeal, and oral cavity cancer is provided by other studies of roofers. Several epidemiological studies have shown excesses of lung and urinary bladder cancer among workers exposed to pitch fumes in aluminum production plants. A slight excess of lung cancer was found among furnace and maintenance workers exposed to coal tar pitch fumes in a calcium carbide production plant. One study showed a small excess of bladder cancer in tar distillers and in patent-fuel workers. An elevated risk of cancer of the renal pelvis was seen in workers exposed to "petroleum or tar or pitch." One study of millwrights and welders exposed to coal tars and coal tar pitch in a stamping plant showed significant excesses of leukemia and of cancers of the lung and digestive organs (IARC S.7, 1987).

In a number of case reports, the development of skin cancer in workers exposed to creosotes is described. One study involved a review of 3,753 cases of cutaneous epithelioma and showed that 35 cases (12 of which were of the scrotum) involved exposure to creosotes. Most cases occurred in workers handling creosotes or creosoted wood during timber treatment. A mortality analysis of workers in many occupations indicated an increased risk of scrotal cancer for creosote-exposed brickmakers (IARC S.7, 1987).

Exposure to mineral oils that have been used in a variety of occupations, including mulespinning, metal machining and jute processing, has been associated strongly and consistently with the occurrence of squamous cell cancers of the skin, and especially of the scrotum. Among 682 turners with 5 or more years of exposure to mineral oils, five cases of squamous cell carcinoma of the skin (four of the scrotum) occurred, with 0.3 expected. In a case-control study, an excess of sinonasal cancers was seen in toolsetters, set-up men, and toolmakers.

One of three mortality studies on manual workers in the printing industry, not specifically addressing printing pressmen, did not show an increased lung cancer risk, whereas the other two studies found a statistically significant excess. One of two mortality studies of printing pressmen indicated a statistically significant increase of deaths from rectal cancer, and the other

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\* There is no separate CAS registry number assigned to tars and mineral oils.

showed a statistically nonsignificant increase of deaths from colon cancer. One mortality study among newspaper and other commercial printing pressmen showed a statistically significant excess of mortality from cancers of the buccal cavity and pharynx, whereas no such excess was observed in a cohort study. One case-control study indicted a statistically significant excess of cancers of the buccal cavity and pharynx (IARC S.7, 1987).

When administered topically in experimental animals coal tars (8007-45-2), coal tar extracts, and high-temperature coal tars (65996-89-6) induced skin papillomas and carcinomas. Pharmaceutical coal tars and tar ointments caused skin papillomas, squamous cell carcinomas, and/or carcinomas when applied to the skin of mice of both sexes. When applied to the skin, coal tar induced epidermoid lung carcinomas in rats, and when applied to the ears of rabbits, coal tar caused skin papillomas. When administered intramuscularly, coal tar fume condensate induced injection site sarcomas in mice of both sexes. Analyses of coal tars indicate the presence of a number of known carcinogens and potentially carcinogenic chemicals which are discussed in the *Ninth Report on Carcinogens*, including benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, dibenzo[a,i]pyrene, and indeno[1,2,3-cd]pyrene (see Polycyclic Aromatic Hydrocarbons, 15 Listings, Section III.B).

When administered topically creosote (8001-58-9), a coal tar distillate, induced skin papillomas and carcinomas in male and female mice and lung adenomas in mice. When applied topically, creosote oils induced skin papillomas and carcinomas in mice of both sexes. Creosote contains several carcinogenic polycyclic aromatic hydrocarbons which are discussed in the *Ninth Report on Carcinogens*, including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene (see Polycyclic Aromatic Hydrocarbons, 15 Listings, Section III.B).

When administered topically or by whole-body exposure, coal tar pitch, a coal tar distillate, induced skin papillomas and carcinomas in mice. When applied topically, coal tar pitch extracts induced skin papillomas and carcinomas in mice; these extracts also had both initiating and promoting activities (in separate studies) in mouse skin. In one study, an extract of a hard residue from a coke oven tar induced lung tumors but no skin tumors in mice (IARC V.7, 1974). Analyses of coal tar pitches reveal the presence of several carcinogenic polycyclic aromatic hydrocarbons which are discussed in the *Ninth Report on Carcinogens*, including benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene (see Polycyclic Aromatic Hydrocarbons, 15 Listings, Section III.B) (IARC V.35, 1985).

Vacuum-distillate fractions, acid-treated oils, mildly treated solvent-refined oils, mildly treated hydrotreated oils, solvent extracts (aromatic oils), and some cutting oils produced skin tumors after repeated skin applications to mice. Similar treatment with high-boiling, catalytically cracked oils produced skin tumors in rabbits and Rhesus monkeys. Some severely solvent-refined oils did not produce skin tumors in mice. Highly refined food-grade mineral oils did not produce skin tumors when applied to the skin of mice, although after intraperitoneal injection they produced plasma cell neoplasms and reticulum cell sarcomas in certain strains of female mice. An IARC Working Group concluded that the latter finding was difficult to interpret (IARC S.7, 1987). Analyses of mineral oils used for medicinal and cosmetic purposes reveal the presence of several carcinogenic polycyclic aromatic hydrocarbons which are discussed in the *Ninth Report on Carcinogens*, including benzo[b]fluoranthene, benzo[k]fluoranthene, and benzo[a]pyrene (see Polycyclic Aromatic Hydrocarbons, 15 Listings, Section III.B) (IARC V.33, 1984).

## PROPERTIES

Coal tars are by-products of the destructive distillation (carbonization) of coal to produce coke and/or gas. The composition and properties of a coal tar depend mainly on the temperature of the carbonization and, to a lesser extent, on the nature (source) of the coal used as feedstock. Coal tars are usually viscous liquids or semisolids that are black or almost black in color. Coal tars have a characteristic naphthalene-like odor. Coal tars are soluble in benzene and nitrobenzene and partially soluble in acetone, carbon disulfide, chloroform, diethyl ether, ethanol, methanol, petroleum ether, and sodium hydroxide. Coal tars are slightly soluble in water. In general, coal tars are complex combinations of hydrocarbons, phenols, heterocyclic oxygen, sulfur, and nitrogen compounds. Over 400 compounds have been identified in coal tars and as many as 10,000 may actually be present. The content of polycyclic aromatic hydrocarbons in coal tars increases as the carbonization temperature increases. Low-temperature coal tars (< 700 °C) are black, viscous liquids that are more dense than water. Low-temperature coal tars are less aromatic than high-temperature coal tars (> 700 °C) containing only 40 to 50% aromatic hydrocarbons.

Creosote, a distillation product of coal tars, is a yellowish dark green to brown oily liquid. It consists of aromatic hydrocarbons; anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycyclic aromatic hydrocarbons make up at least 75% of creosote.

Coal tar pitch is a shiny, dark brown to black residue produced during the distillation of coal tars. Pitch contains various polycyclic aromatic hydrocarbons and their methyl and polymethyl derivatives, as well as heteronuclear compounds.

Mineral oils, refined from petroleum crude oils, are complex mixtures of straight- and branched-chain paraffinic, naphthenic, and aromatic hydrocarbons with 15 or more carbons and boiling points in the range of 300 to 600 °C. Paraffinic crude oils are characterized by high wax content, high natural viscosity index (the rate of change of viscosity over a given temperature range), and relatively low aromatic hydrocarbon content. Naphthenic crude oils are generally low in wax content and relatively high in cycloparaffins and aromatic hydrocarbons. All crude oils contain some polycyclic aromatic compounds, and the proportions and types of these compounds in finished base oils are determined mainly by the refining processes. Medicinal white mineral oils are clear, tasteless, and odorless at room temperature with little odor after heating. Some medicinal and technical-grade white mineral oils may contain up to 10 mg/kg  $\alpha$ -tocopherol as an antioxidant. Polycyclic aromatic hydrocarbons have been detected in white mineral oils.

## USE

Coal tar is primarily used for the production of refined chemicals and coal tar products such as creosote, coal tar pitch, and crude naphthalene and anthracene oils from the distillation of crude coal tar. It is also used as a fuel in open-hearth furnaces and blast furnaces in the steel industry. Coal tar is suitable as a fuel because of its availability, its low sulfur content, and its high heating value. Both high-temperature and low-temperature coal tars are used to treat psoriasis and other chronic skin diseases. Coal tar products are also used in numerous pharmaceutical products including creams, ointments, pastes, lotions, bath and body oils, shampoos, soaps, and gels. The coal tar products present in these formulations include coal tars (0.18-10%), coal tar solution (2-48.5%), coal tar extract (5%), tar distillate (3-25%), coal tar fraction (1.25%), and acetyl alcohol coal tar (4%). Coal tar extract is also used in neomycin sulfate-hydrocortisone ointment. USP-grade coal tar is approved for use in denatured alcohol.

Coal tar is also used as a binder and filler in surface-coating formulations and as a modifier for epoxy-resin surface coatings (IARC V.35, 1985).

Creosote is primarily used for the preservation of wood (IARC V.35, 1985), accounting for over 97% of current coal tar creosote production (ATSDR, 1996-K026). Creosote is used to treat railway sleepers, poles, pilings, lumber and timber, railway-switch sleepers, fence posts, and other wood products. Creosote is registered for use as an animal and bird repellent, animal dip, miticide, fungicide, herbicide, and insecticide; however, it is currently used in only limited quantities as an animal and bird repellent, as an insecticide (ovicide), and as an animal dip. Creosote is also used in a tap-hole refractory cement which is used to close openings in furnaces or ovens after material has been withdrawn. Creosote has also been used as a frothing agent in mineral flotation and as a feedstock for the production of carbon blacks (IARC V.35, 1985). It has also found application as an antiseptic, astringent, antipyretic, disinfectant, and styptic (HSDB, 1997). Suggested uses include oral applications for colds, influenza, diarrhea, and urinary tract infections and topical applications for dandruff (ATSDR, 1996-K026).

Coal tar pitch is primarily used as the binder for aluminum smelting electrodes (IARC V.34, 1984). Pitches are also used in roofing materials, surface coatings, black varnishes, and pipe-coating enamels. Coal tar pitch is used to impregnate and strengthen the walls of brick refractories. Hard pitch is used as a binder for foundry cores. Coke oven pitch is used to produce pitch coke which is used as the carbon component of electrodes, carbon brushes, and carbon and graphite articles. Distillation fractions and residues from high-temperature coal tars are used in the production of naphthalene, recovery of benzene, production of anthracene paste, briquetting of smokeless solid fuel, impregnation of electrodes and fibers, manufacture of electrodes and graphite, and for road paving and construction (IARC V.35, 1985).

Mineral oils are primarily used as lubricant base oils to produce further refined oil products. These products include: engine oils, automotive and industrial gear oils, transmission fluids, hydraulic fluids, circulating and hydraulic oils, bearing oils, machine oils, machine-tool oils, compressor and refrigerator oils, steam-engine oils, textile machine oils, air-tool oils, metalworking oils (cutting oils, roll oils, can-forming oils, drawing oils), rust preventative oils, heat-treating oils, transformer oils, greases, medicinal and technical-grade white oils, and processing oils (product extenders, processing aids, carriers and diluents, water repellents, surface-active agents, batching oils, mold-release oils, wash oils). These oils are used in manufacturing (78.5% of the oils produced), mining (5.0%), construction (1.8%), and miscellaneous industries (14.7%). Approximately 57% of the lubricating oils produced are used by the automotive industry and the remaining 43% by other industries. In the automotive industry, lubricating oils are used as multigrade engine oils (23% of the lubricating oils produced), monograde engine oils (22%), transmission and hydraulic fluids (8%), gear oils (2%), and aviation oils (1%). Other industrial uses for lubricating oils include general industrial diesel engine oils (19%), process oils (13%), metalworking oils (4%), railroad diesel engine oils (3%), and marine diesel engine oils (2%). Technical-grade white oils are used in cosmetics (hair oils, creams), textile-machine lubricants, horticultural sprays, wrapping paper, for corrosion protection in the meat-packing industry, and as lubricants for watches, bicycles, and spindles. Medicinal white oils are used in pharmaceutical preparations (processing aids, intestinal lubricants), food additives (release agents, binders, flotation sealants, defoamants, protective coatings), food packaging and processing, and animal feed products. Medicinal white oils are also used in the chemical and plastics industry as processing media, extenders, and plasticizers (IARC V.33, 1984).

## PRODUCTION

Coal tar was first produced in the United States in 1913, when over 1.0 billion lb of coal tar were produced as a by-product of coke production (IARC V.35, 1985). It is produced chiefly by the steel industry as a by-product of the manufacture of coke. Production, therefore, depends on the demand for steel. In 1994, the annual US production was 1.8 billion lb (USITC 1993-1995).

Creosote was first produced commercially in the United States in 1917 (IARC V.35, 1985). Its production falls into two categories: distillate (100% creosote) and creosote in coal tar solution (ATSDR, 1996-K026). In 1994, the annual US production was 2.53 million lb for distillate and 539 million lb for creosote in coal tar solution (USITC 1993-1995).

In 1981, approximately 19 billion lb of mineral oil products were used in the United States (NPRA, 1981). These products included 16.2 billion lb of lubricating oils, 1.5 billion lb of waxes, 814 million lb of aromatic oils, and 462 million lb of greases.

## EXPOSURE

The primary routes of potential human exposure to coal tar and coal tar products are inhalation, ingestion, and dermal contact. Occupational exposure of workers to coal tars and pitch may occur during coke production, coal gasification, aluminum production, and at foundries. NIOSH estimated that 145,000 workers were employed in operations that involve coal tar products. OSHA reported that approximately 10,000 coke oven workers were potentially exposed to coal tar in the workplace (IARC V.34, 1984). NIOSH reported pitch volatile concentrations (benzene soluble fraction) ranging from 0.4 to 12.0 mg/m<sup>3</sup> as an 8-hr time-weighted average (TWA) at three aluminum production facilities. NIOSH estimated that all workers at these facilities were potentially exposed to pitch volatiles at a concentration of 3.4 mg/m<sup>3</sup> as an 8-hr TWA (NIOSH, 1974). Workers in the coal gasification industry and iron and steel foundry industry are also potentially exposed to pitch volatiles including a variety of polycyclic aromatic hydrocarbons (IARC V.34, 1984). OSHA estimated that 121,000 workers were potentially exposed to tars, and approximately 2,500 workers at 50 plant locations in the United States were potentially exposed to coal tar pitch volatiles (CTPVs) while coating metallic pipes with hot coal tar enamels (Larson, 1978). Exposure of the general population to coal tar may occur through its use in treating skin disorders. Nearly 2% of the United States population is affected by psoriasis, one of the conditions for which coal tar ointments (containing 1%-10% coal tar) is prescribed (IARC V.35, 1985). The general population may also be exposed to tars that are present as environmental contaminants.

Potential occupational exposure to creosote, which occurs by inhalation of volatilized components or direct dermal contact, is greatest among individuals working in the wood-preserving industry (ATSDR, 1996-K026). The major source of creosote released to the environment is wastewater effluents from such wood treatment facilities (USDA, 1980). According to the Toxics Release Inventory of 1995, an estimated total of 1,152,129 lb of coal tar creosote (99.2% of the total environmental release) was discharged to air, while 8,039 lb (0.7%) were discharged to water from manufacturing and processing facilities in the United States in 1993. The remaining 0.1% of total environmental release was creosote (1,528 lb) discharged to water. The data, however, should be used with caution since only certain types of facilities were required to report (ATSDR, 1996-K026). Companies that preserve wood with creosote may treat aqueous wastes in on-site biological treatment plants or release the wastewater into a municipal water treatment system. Some creosote components may also be released to the atmosphere by

inadvertent emissions from these facilities, but compared with releases to surface water and soil, creosote releases to the atmosphere are considered to be insignificant. Exposure may occur during handling and installation of treated wood products in structures such as bridges, piers, retaining walls, crossties, and fencing; as a result of burning treated scrap wood; and through contact with contaminated media at hazardous waste sites. NIOSH reported occupational exposure to creosote (measured as CTPVs) in the air by various work operations in United States wood preservative facilities, including the following: treating operator, 0.007-1.343 mg/m<sup>3</sup>; locomotive operator, 0.013-0.159 mg/m<sup>3</sup>; switchman, 0.045-0.035 mg/m<sup>3</sup>; sample borer, 0.04-0.05 mg/m<sup>3</sup>; and forklift operator, 0.010-0.020 mg/m<sup>3</sup> (NIOSH, 1983; USDA, 1980). The Department of Agriculture estimated that about 100 commercial thermal and dip-treatment workers in wood preservative facilities have consistently high potential inhalation exposure to creosote, and approximately 4,000 commercial pressure-treatment workers have occasional high potential inhalation exposure to creosote. Skin contact was considered minimal except among maintenance workers, who were estimated to have occasional high potential exposure (USDA, 1980). Today, as a result of the use of engineering controls and personal protective equipment, the 25,000 workers employed in 75 to 100 U.S. treatment plants using coal tar creosote are exposed to creosote components below the OSHA permissible exposure limit (ATSDR, 1996-K026). In a United States refractory cement plant, the concentration of CTPVs was determined to be in the range of 0.03 to 1.42 mg/m<sup>3</sup> (IARC V.35, 1985). The general population may be exposed to creosote through contact with creosote-treated wood products, from the incineration of creosote-treated scrap lumber, contact with contaminated environmental media such as groundwater near hazardous waste sites, and from the use of coal tar shampoos for anti-dandruff therapy (ATSDR, 1996-K026).

Potential occupational exposure to coal tar pitch (usually measured as CTPVs) can occur for workers producing or using pavement tar, roofing tar, coal tar pitch, coal tar paints, coal tar coatings, coal tar enamels, and refractory bricks. NIOSH estimated that approximately 500,000 workers were potentially exposed to asphalt fumes in their work (NIOSHb, 1979a). The ambient air concentrations of polycyclic aromatic hydrocarbons near roof tarring operations ranged from 0 to 200 µg/m<sup>3</sup>, and 0 to 3700 µg/m<sup>3</sup> near pavement tarring operations (IARC V.35, 1985). Another study found that pitch workers at a U.S. roofing site inhaled up to 53 mg of benzo[a]pyrene in 7 hours (IARC V.35, 1985).

NIOSH reported that a felt machine operator was potentially exposed to CTPVs (cyclohexane-soluble fraction) at a concentration of 0.11 mg/m<sup>3</sup>. Painters using coal tar paints at a metal products plant were potentially exposed to CTPVs at a TWA concentration of 0.48 mg/m<sup>3</sup> (NIOSH Hazard, 1980). The concentration of CTPVs (benzene-soluble fraction) at a plant manufacturing a plastic pipe covering [mixture of coal tar, bitumen, and powdered poly(vinyl chloride)] ranged from 0.18 to 4.41 mg/m<sup>3</sup> (NIOSH Hazard, 1976). Industrial hygiene surveys conducted at eight U.S. plants which coated pipes with coal tar enamel indicated that the mean potential exposure to CTPVs in the coating operations was 1.9 mg/m<sup>3</sup>. Coating operators and kettle tenders were potentially exposed to mean concentrations of 6.5 mg/m<sup>3</sup> and 2.3 mg/m<sup>3</sup>, respectively (Larson, 1978). CTPVs (benzene-soluble fraction) were detected at 0.03 to 3.01 mg/m<sup>3</sup> in several breathing zone and area samples during the carbon-carbon impregnation and densification processes at a United States fiber plant using coal tar pitch (NIOSH Hazard, 1979). The potential for skin exposure may be considerable for coal tar and pitch workers because they often wear little clothing due to the heat, exposing large portions of the body to CTPVs. In the skin oil of nine roofing workers (potentially exposed to coal tar pitch and bitumen), polycyclic aromatic hydrocarbons were detected at concentrations of 0.048 to 36 ng for a 36-cm<sup>2</sup> area of the forehead (Wolff et al., 1982).

The primary routes of potential human exposure to mineral oils are inhalation, ingestion, and dermal contact. The major hydrocarbon constituents of lubricant base oils and derived products occur naturally in crude petroleum. The general population is potentially exposed to unused and used mineral oils that are naturally occurring or present as environmental contaminants. Approximately 528 million gal of used lubricating oils are released into the environment every year, including approximately 198 million gal used as road oil or in asphalt. Potential occupational exposure to mineral oils can occur for workers employed in the manufacture of automobiles, airplanes and parts, steel products, screws, pipes, precision parts, and transformers, as well as workers employed in brass and aluminum production, engine repair, copper mining, and newspaper and commercial printing (IARC V.33, 1984). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 6 million workers in nonagricultural industries were potentially exposed to mineral oils, 2 million to lubricating oils, 1 million to cutting oils, and 1 million to motor oils (NIOSH Hazard, 1976). NIOSH reported the presence of mineral oils in the occupational environment of several plants. The concentration of cutting oil mist was reported to be 0.37-0.55 mg/m<sup>3</sup> for polishing aircraft engine blades; 0.4-6.0 mg/m<sup>3</sup> for machining rough iron castings into auto parts; 1.1-20 mg/m<sup>3</sup> for manufacturing aircraft components; 0.3-1.3 mg/m<sup>3</sup> for manufacturing automotive parts; < 0.03-0.8 mg/m<sup>3</sup> for fabricating precision metal parts; and < 0.035-3.1 mg/m<sup>3</sup> for milling and machining operations. The concentration of transformer oil in the workplace was reported to be 0.1-1.4 mg/m<sup>3</sup> for manufacturing and overhauling large transformers (IARC V.33, 1984). Oil mist concentrations from the use of cutting oils ranged from 0.2-2.9 mg/m<sup>3</sup> at three United States plants (NIOSH, 1978). Oil mist concentrations in three machine shops equipped with lathes, mills, grinders, and sharpeners ranged from 0.07-110 mg/m<sup>3</sup> (Ely et al., 1970). Oil mist levels in a New York City pressroom ranged from 5-21 mg/m<sup>3</sup> (IARC V.33, 1984).

## REGULATIONS

CPSC regulates the formation of creosotes in coal and wood burning appliances. EPA regulates creosote and coal tars under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA), which establish a final reportable quantity (RQ) of 1 lb for both compounds. Under SARA, EPA requires specific reporting requirements for creosote. Coal tars and creosote are also regulated under the Clean Air Act (CAA); EPA has set national emission standards for point and stationary source categories. Under the Resource Conservation and Recovery Act (RCRA), wastes containing these chemicals are subject to report/recordkeeping requirements under the hazardous waste disposal rule. EPA regulates mineral oils under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which restricts the use of pesticides containing these substances and establishes tolerance concentrations for residues, and the Toxic Substances Control Act (TSCA), which describes how to dispose of mineral oil dielectric fluid from polychlorinated biphenyl-contaminated equipment. FDA requires warning labels on cosmetics containing coal tar products and has determined that coal tar shampoos are generally recognized as safe. The FDA Advisory Panel on over-the-counter drug products determined that coal tar is not safe for use as a topical antifungal agent. FDA recommends warning labels for over-the-counter products and animal feeds containing creosote. White mineral oils are regulated by FDA as direct and indirect food additives. FDA also regulates mineral oils as additives in animal feed. FDA recommends warning labels for drugs containing mineral oil that are taken internally and classifies over-the-counter drug products containing mineral oil as generally recognized as safe. NIOSH recommends a permissible exposure limit (PEL) of 0.1 mg/m<sup>3</sup> for coal tar, coal tar pitch, and creosote (cyclohexane-soluble fraction). NIOSH recommends a ceiling of 5 mg/m<sup>3</sup> as a 10-hr TWA for asphalt fumes. OSHA has established a PEL of 0.2 mg/m<sup>3</sup> as an 8-hr TWA for CTPVs (benzene-soluble fraction), 5 mg/m<sup>3</sup>

for mineral oils, and 2,000 mg/m<sup>3</sup> for naphtha (petroleum distillates). OSHA also regulates tars, and mineral oil as chemical hazards in laboratories under the Hazard Communication Standard. Regulations are summarized in Volume II, Table A-39.